IPE
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PATENT AND TRADEMARK OFFICE

ACTIVE FORCE GENERATION/ISOLATION SYSTEM EMPLOYING MAGNETO RHEOLOGICAL FLUID (MRF)

Technical Field

[0001] This invention relates to vibration isolators, and more particularly, to a new and useful isolation system for minimizing in-plane vibrations produced in a rotating system, and still more particularly, to an isolation system that employs a Magneto Rheological Fluid (MRF) as the working inertial mass of the system. The MRF isolation system minimizes system weight, aerodynamic drag, and complexity while concomitantly providing active control and adjustment during operation for optimal efficacy across a wide spectrum of operating speeds.

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Background of the Invention

[0002] Vibration isolation and absorption is often desirable for nulling or canceling vibrations associated with a rotating system. Such vibrations, when left unattenuated or unabated, may lead to structural fatigue and premature failure of system components. Furthermore, inasmuch as such vibrations may be transmitted through adjacent support structure to, for example, an aircraft avionics bay or to areas occupied by passengers, other components and cabin area remote from the source of the vibration, may be subject to these same potentially damaging or disturbing vibrations (albeit perhaps lower in amplitude due to energy absorption by the interconnecting structure). Consequently, it is most desirable to isolate or absorb these vibrations at or near the source of the vibration in the rotating system.

[0003] One application which best exemplifies the need for and advantages derived from vibration isolation/absorption devices is the main torque driving hub of a helicopter rotor system. Typically, the main rotor of a helicopter, which comprises a central torque drive hub member for driving a plurality of lift producing rotor blades, is subject to a variety of aerodynamic and gyroscopic loads. For example, as each rotor blade advances or retreats relative to the freestream airflow, it experiences a sharp rise and fall of in-plane aerodynamic drag. Furthermore, as the tip of each rotor blade advances with each revolution of the rotor system, the relative velocity seen by the blade tip approaches supersonic Mach numbers. As such, large variations are caused to occur in the various coefficients which define blade performance (e.g.,